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G. WARREN DRESSER, Editor,

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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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OFFICIAL NOTICE.

BOSTON, MARCH 1ST, 1877.

G. WARREN DRESSER.

Editor AMERICAN GAS-LIGHT JOURNAL—

Dear Sir: At the Annual Meeting of the New England Association of Gas Engineers, held at the Tremont House, Boston, February 21st, 1877, it was voted: "That the AMERICAN GAS-LIGHT JOURNAL be hereby constituted the official organ of the New England Association of Gas Engineers."

Yours, truly,
GEO. B. NEAL,
Secretary of Association.

Birmingham Corporation Gas Works.

This works is being conducted under the management of the city authorities, and the report recently published shows that the works have sold, during the past year, 2,655 million feet being an increase of nearly three per cent. over the sales of last year. The net profit for the year, as shown, is £34,000, exclusive of £4,000 placed to the credit of the depreciation fund.

The amount received for residual products was over £118,000.

The amount of coal carbonized was 321,000 tons. The amount of tar per ton of coal was 10½ gallons. The coke and breeze made, per ton of coal, was 1.14 chaldrons. The coke and breeze used was 23¾ per cent. of all the coke made. The report complains of the extreme dullness of the times in the manufacturing interests of the city, and the consequent falling off in consumption, and in the coke sales.

These works have been run under the city management for about two years. The price of gas is about as low as anywhere in England and £30,000 have been handed over to the general treasurer of the city. This is not altogether satisfactory to all concerned, as will be seen by the following extracts from a Birmingham Daily and the London *Journal of Gas-Lighting:*

APPROPIATION OF GAS PROFITS AT BIRMINGHAM.

[*From the Birmingham Daily Gazette.*]

The figures we have quoted show at a glance where the money goes which should be employed for increasing the reserve-fund, if not for other purposes directly connected with the gas supply. Of the net profits in the year, of £34,000 and odd, the borough treasurer takes £30,000 for purposes other than those connected with the gas department. In fact, that department is a milch cow to the Town Council, and it is questionable if it is not over-milked to a dangerous extent. This, indeed, was the question which chiefly occupied the time and attention of the council when the gas report was under discussion. Mr. Beard set forth, certain views on the point which were not favored by the council as a body, but which are, nevertheless, in perfect harmony with all recognized financial rules and economic principles. He contended that there ought to be no such mixing up of accounts as that which at present prevails by favor of the council. Repeating the arguments which he recently advanced in a letter printed in these pages, he urged that it is manifestly unjust for the gas consumers, who are less than half the entire number of ratepayers, to pay general rates twice over—once directly, and once through the profits which they contribute to the gas accounts. A more satisfactory, regular, and equitable way would be to treat the gas as it is proposed to deal with the water—viz., to give every encouragement to householders to consume gas, charging to all classes rates from year to year sufficient only to pay working establishment expenses, interest on capital, and to set aside yearly a sum to be agreed upon to redeem the debt created for the purchase, so as to reduce the price to all consumers to the lowest minimum consistent with proper maintenance of the service. There is really no gainsaying those arguments, and it is surprising that their absolute soundness does not commend them to the approval of the many men of business who form a majority of the Town Council. The gas monopoly which the council claims and enforces should be kept free from the sin of the most objectionable monopolies of former times—excessive profits. The consumers should in justice get the benefit of any surplus profits that are made on the sale of gas, always allowing an ample margin for contingencies; and it is a most vicious financial policy to tax such consumers in order to raise money for genera rating purposes. It is unjust to the gas consumers, who are thus made to contribute twice to the rates; it is demoralising to the Town Council, which imposes such a duplicate tax on a special class of its subjects; and it is misleading to the ratepayers at large, who are thus deceived as to the real cost of government. Moreover, there is one class of consumers which has a special right to object to this system of indirect taxation. We refer to those gas consumers who reside beyond the limits of the borough. Whatever may be said in defense of the principle of charging unnecessary high gas rate to residents in the borough—as that they derive some benefit from the profits

extracted from them, by other rates not being so high as they otherwise would be—it is obvious that no such defence can be made to the complaints of the outside consumers that they are made to pay Birmingham borough rates through the gas account.

Neither to the borough nor the extra-borough consumers is it any fair answer to say that the price charged for the gas, notwithstanding the excess of profit made, is reasonable and well below the maximum. When a governing body takes into its hands the supply of such essentials to health, comfort, and general well-being as gas, water, and the like, it should not do so for the purpose of securing large gains to be devoted to other purposes, in the manner of an ordinary trading company. The great object and intention of the Legislature in vesting corporations with the power of becoming owners and manufacturers in certain generally required commodities was to secure their cheap, regular, and abundant supply, as essential to the interests of the people at large. It was not contemplated to make that supply a source of profit to be applied to general local purposes. It was designed beyond question to leave the expenditure for such purposes to be met in the ordinary way by the levying of direct rates, and to cheapen the cost and encourage the consumption of such things as gas and water by giving the consumers the full benefit of any profits made by their sale. It is true that the Birmingham Corporation Act, 1875, has a safety-valve clause allowing any stray surplus profits, after the formation of a large reserve-fund and the payment of all direct and incidental expenses, to be absorbed in the borough rates; but this, in the intention of the Legislature, is obviously far removed from any idea that a system should be instituted of making regular excess profits, at the cost of the gas consumers, to be applied to other purposes. Look at the matter as we may, it is evident from every point of view that such a system is economically wrong, grossly unfair to one section of the ratepayers and misleading for the other, and altogether condemnable.

No doubt the town is to be congratulated on the great success of the gas venture, but the twice-taxed consumers will not be favorably impressed with the policy of wringing large surplus profits from them in order that the other ratepayers should benefit thereby.

The *Journal of Gas Lighting* remarks:

"The question as to the proper application of gas profits has come up again in Birmingham, and we find one of the Corporation auditors contending, in a very able letter, that surplus profits belong to the consumer, who is, as we maintain, subjected to additional taxation when these profits are devoted to public purposes. This fact is brought out strongly when the statement is made, that in the borough of Birmingham "only half the householders are consumers of gas, and that only about one-third of the ratepayers may be said to be profit-paying consumers." If this statement be true—and we cannot suppose that Mr. Beard speaks without an accurate knowledge of the facts—the policy for the Gas Committee to pursue is evident enough. Cheapen gas to the lowest possible limit, and so promote a more general consumption. When every ratepayer is a consumer, it does not matter how gas profits are appropriated."

As to a city management of gas works in this country we cannot conceive of anything that could be worse for the consumer and the public. Our city officials, as a general rule, in this land of liberty have full as much business as they can well attend, and, in Heaven's name, do not throw the manufacture of gas upon them in addition. What would be the number of men employed, per retort, just before election? and what the cost of gas?

Report of the Proceedings of the New England Association of Gas Engineers.

[OFFICIAL]

The Annual Meeting of the New England Association of Gas Engineers was held at the Tremont House, Boston, on Wednesday, February 21st, 1877.

The President, George D. Cabot, Esq., at ten o'clock, A. M., took the chair and called the meeting to order.

The roll was then called by the Secretary, and forty-seven members answered to their names.

Mr. Charles Nettleton, Secretary of the American Gas-Light Association, Mr. G. Warren Dresser, Editor of the American Gas-Light Journal, and Captain Fred. S. Benson, Engineer of the Nassau Gas-Light Company, Brooklyn, L. I., were present by special invitation, and were requested to take part in the discussions of the meeting if they should desire to do so.

Other gentlemen, connected with gas companies in New England and elsewhere, were present by invitation of individual members. The record of the last meetting was read by the Secretary, and, after a slight amendment, was approved.

A letter from Gen. Charles Roome, President of the Manhattan Gas Company, New York city, was read, accepting the invitation to be present, and expressing the great pleasure it would afford him to meet his brethren of the profession on so interesting an occasion. Letters were also read from Capt. W. H. White, of the Citizens Gas-Light Company, Brooklyn, N. Y., and Geo. A. McIlhenny, Esq., of the Washington Gas-Light Company, D. C., regretting their inability to attend the meeting in response to the invitation tendered to them, and expressing their wishes for the success of the Association.

The Secretary presented the names of the following gentlemen, approved by the Board of Directors, to be proposed for membership, viz:

H. S. Crowell	of Marlboro Gas Co.	Mass.
J. H. Burnham	of East Boston "	"
Andrew Hutchinson	of Providence "	R. I.

and they were duly elected by ballot.

Col. Armington—At the meeting of the Directors held last evening, the subject of honorary membership came before them for consideration, and it was with great pleasure that I presented the names of Gen. Charles Roome and George W. Edge, Esq., to be proposed to this Association for election as its first honorary members. As such they will not only confer honor upon the Association, but the Association will honor itself by thus electing them. In all branches of business there are always some persons who are looked up to; those who have been longest connected with the business, and who are often called upon for advice. The two gentlemen I have just named, as all will admit, are of that description, and they have been prominent in our profession for many years.

To Gen. Roome, and Mr. King of Liverpool, are we indebted for our present standard for testing gas. The former gentleman stated to me, several years ago, that he had spent some two or three months making experiments for a burner as a standard of illuminating power. He has for many years been at the head of one of the largest gas companies in this country, and under his wise management it has been very prosperous.

Mr. Edge, although eminent in his profession, is, as you all know, very modest and unassuming as regards his merits as a skilful gas engineer and inventor.

He has given us two of the best inventions in use by our profession—the compensator and the process for scurfing retorts. It gives me great pleasure, in behalf of the Directors, to propose the names of these two gentlemen for honorary membership.

A ballot was then taken, and they were unanimously elected.

The treasurer then presented and read his annual financial report, which was in substance as follows: viz.

Balance as per last report		790.23
Since received for fees of membership		335.00
		1125.23
Deposited in two Savings Banks, $500 each	$1000.00	
Paid sundry bills as per statement	126.89	1126.89
Balance due Treasurer		$1.66

Mr. Stiness for the auditing committee reported that they had examined the books, accounts and vouchers of the treasurer, and had found them correct.

Voted, that the above reports be accepted and placed on file.

Voted, to proceed to the choice of officers for the ensuing year, and that a committee of three be appointed by the chair to report a list of names to be balloted for by the association.

The chair appointed Messrs. Geo. Dwight, David Moore and O. E. Cushing as that committee, and they retired for consultation.

The president stated that if any gentleman had any thing to present to the meeting or any remark to make, an opportunity so to do was now afforded.

Mr. Stiness presented for the inspection of the members a pressure-gauge which he had caused to be constructed, combining simplicity and durability, and costing a reasonable sum. He did not claim the style or pattern as original with him, as gauges somewhat similar to this had been in use in the Boston Gas Works for many years. The price charged for a similar article by a manufacturer having been thought unreasonable, Mr. Stiness, in consultation with Mr. Stedman, had undertaken to design a guage, which in its construction might combine simplicity and efficiency at a moderate cost. The sample gauge was then examined, and its merits discussed.

The Secretary read a request from Mr. Charles H. Porter, asking leave to withdraw from the Association.

Voted that his request be granted.

A letter from Mr. James W. North was also read, in which he stated that he had received a notice of his election as a member, but that as he did not consider himself as eligible, and had no doubt that his name had been proposed by mistake, he declined the election, which declination was accepted.

The President—Are there any reports to be presented, or any papers to be read?

Mr. Lamson—I have a matter that I wish to speak upon. It is a plan which I have thought of for making our meetings more interesting, and which will serve as a substitute for a lecture which we have often tried to have, but have not succeeded. At a meeting of the Directors, held several months since, a committee was authorized to procure a lecture from Prof. Wood, who was one of the members of the Boston Gas Commission, which no doubt would, if delivered, have been

highly interesting and instructive, but on account of other pressing engagements he was obliged to decline to do so. I think the plan I wish to propose for your consideration will render our meetings more interesting and beneficial, if fully carried out by the members. It is this, that certain members of the Association prepare papers previous to the next semi-annual or annual meeting, accompanied by illustrations in the form of tables of figures, or of diagrams or plans; that such tables etc. be presented to the Directors for heir inspection, and if they judge it expedient to cause them to be photographed by Mr. Black, or some other competent artist, and authorize the expenditure, that the same be exhibited at the meeting while members are reading their papers.

This would afford an opportunity for all present to see the illustrations. Now, it is impossible for the audience generally to fully understand what is read, for they cannot all see the figures, etc., explanatory of what is read. I think this thing can be accomplished at a reasonable expense.

I have gathered together material for an interesting paper, but cannot bring it properly before the Association without the aid of maps, diagrams, etc. Mr. Black thinks that for forty or fifty dollars he can prepare something of the kind I have suggested, which will be but a small sum for the Association to expend for so good an object. Such an exhibition by a competent person, with the stereopticon, would be of incalculable value to us all, and will serve to increase the interest of the members in these meetings.

The nominating committee being now ready to report, it was voted that the subject be laid on the table for the present.

Mr. Dwight—The committee appointed to nominate a list of officers of the Association for the ensuing year have attended to that duty, and are now prepared to report; but, before doing so, they would say that they would have presented for the office of President the name of the present occupant of the Chair, had not he, in the most positive terms, assured them that he should decline a re-election.

The committee, while regretting his decision, and expressing their appreciation of his valuable services during the time he has occupied the position of presiding officer of the Association, have reluctantly yielded to his wishes, and have, therefore, substituted for his name that of another gentleman whom, we think, you will be glad to place in the Chair.

We nominate the following gentlemen for the several offices established by our constitution:

For President—Samuel G. Stiness, of Pawtucket, R. I.

Vice Presidents—F, C. Sherman, of New Haven, Conn., and L. P. Gerould, Newton, Mass.

Directors—John M. Hill, Concord, N. H.; Jas. H. Armington, Brooklyn, N. Y.; W. A. Stedman, Newport, R. I.; W. H. Perry, Bangor, Me.; Chas. D. Lamson, Boston, Mass.

Secretary and Treasurer—Geo. B. Neal, Boston, Mass.

The report of the committee was accepted, and a ballot having been taken, all the persons nominated were unanimously elected to the respective offices named in the report of the committee.

Mr. Cabot—Before retiring from the chair I have but a word to say. I am much pleased with the selection you have made, for I think Mr. Stiness will make an excellent presiding officer of this Association, and that in the responsible position in which you have seen fit to place him he will render great service to us. And, now, I wish to thank you, one and all, for your kindness and consideration extended towards me during the whole time I have presided over your deliberations.

Mr. Stiness, on taking the chair, said—Gentlemen of the Association, in accepting this position I am at a loss how to properly express myself in appreciation of the honor conferred upon me; but I do assure you that I esteem this election one of the highest honors which has ever fallen to my lot, and when I consider for one moment who have been my predecessors in office, I almost shrink from its acceptance. You who formed this Association well remember the circumstances of its inception, and its subsequent history. Those who have preceded me in office have mapped out the pathway so plainly that "he who runs may read." I believe that if I follow their footsteps I shall have nothing to fear. Gentlemen, I thank you.

The Secretary—At a meeting of the Directors, held last evening, the following papers were presented to them for their approval, viz: On "Testing Meters," by Mr. Sherman; on "Burners," by Mr. Lamson; on "Temperature of Retorts," by Mr. M. S. Greenough; and on "Statistics," by Col. Armington. These papers were approved, and will be read during the session.

It is hoped that the reading of each paper will lead to general discussion of the subject treated of.

The subject presented by Mr. Lamson, in regard to the illustration of papers by the stereopticon, was then taken from the table.

Col. Armington—I wish to offer an amendment to Mr. Lamson's proposition. The Treasurer reports that there is now invested a thousand dollars of the funds of the Association. Our income this year will be considerable, and it is my impression that, in order to bring out the best talent and experience of our members, the executive committee should be authorized to award some fifty or one hundred dollars to the person offering the best dissertation or essay, on any subject connected with our business.

Other amendments were suggested, but no action was taken upon them, for, at the suggestion of the President, it was voted that the whole subject be referred to a special committee, with directions to prepare a suitable resolution or vote, embodying as far as possible the views of the gentleman who had spoken on the subject. The chair appointed as that committee, Messrs. Lamson and Armington.

The President—We are now ready to listen to the reading of papers.

Mr. Sherman—I have prepared a few statistics on testing meters, taken from the books of my company. I do not flatter myself that I have written anything which will be new to you. Our machinery and apparatus for making gas is regarded by the public generally, as a mere conjuring box. If I shall enlighten the minds of any, or disabuse them of any false impressions, I shall accomplish what I intended in preparing this paper.

On Testing Meters.

Gentlemen: The success of a gas-light company depends fully as much upon their distribution as on their manufacture. They may have the most approved and costly apparatus for generating gas, and obtain the best results, but if their mains and services are leaky, and their meters defective, their results will not be satisfactory. The income is from the gas accounted for. To get the best results you must have the best meter that can be had, and give care and attention to it.

In selecting meters the price should be of secondary consideration—accuracy of measurement, excellence of stock and workmanship should be first secured, and the price afterwards considered. Every gas company should have its own badge and number on its meters, and such records should be kept as will enable the manager to trace the meter from the time of its purchase to the time of its condemnation. This record should show the company's number, the maker's name number and date, when proved, and percentage of error, defects, when repaired, and by whom, and time in use. With this record before him, the manager will know whose meters serve him best. Meter makers will generally warrant them for five years, and this may be taken as the length of time they will run without repairs; after this they should be periodically inspected and their cases painted.

Too much stress cannot be laid upon systematic inspection. Like every other human invention they require care and attention. Such a point of excellence has been arrived at in their manufacture, and they require so little attention, that many managers neglect them entirely, and do not look after them until they cease registering, and the company has suffered a loss thereby. As often as once in three years they should be taken down and inspected. For scientific accuracy of measurement the wet meter must be preferred; but, as it is not practicable to use it in our climate, without subjecting our customers to annoyance and expense. we must use the dry meter. An overworked meter will not register correctly. Consumers are constantly adding to their burners, and before the manager is aware of it the meter is overworked. I need not add that the quality of the gas affects the working of the meter. Gas not properly condensed or overcharged with ammonia and sulphur will speedily render inaccurate the best meter. Dry meters should not be used to register oil gas. The loss in meters comes principally from the lifting of the valves from their seats; unless these are kept cleaned there is a constant leakage going on during the working of the meter. From this cause the small jets left burning by our consumers during the night are a loss to our companies. Another source of loss is from large meters. These will often pass a certain quantity of gas without registering. I recently had occasion to inspect a 50-light meter, which was correct with its normal consumption, but would pass six feet an hour without registering

At the last meeting of the American Gas-Light Association, Mr. Cathels said: "It is a well-known fact, in a large establishment where there is a 20-light dry meter, that, in a majority of instances, it is most unfortunately true that when these lights are turned down very low, the gas is not registered. There is just a sufficient film between the valves to allow the gas to pass through without being registered." In the London *Gas-Light Journal*, vol. 26, p. 72, Mr. Johnson, of the Chartered Company, London, at the meeting of the British Association of Gas Managers, 1875, is reported as follows: "He believes that dry meters, up to ten lights, were sufficiently correct for use, and might be depended upon, supposing them to be periodically tested. In his district there was a large number of meters in buildings where there was a considerable day consumption of gas, and he found that this consumption had been going on at the entire cost of the company; the large dry meters allowing 1, 4, 5, up to 20 and 50 lights to be used without any registration at all."

The above quotations from Messrs. Cathels and Johnson show the importance of periodical inspection of meters.

The company I represent have, during the past four years, inspected and proved 7,550 meters, with the following results: 5,998 meters were correct; 1,318 meters were slow; 193 meters were fast; 46 meters were stopped; say, four-fifths registering correctly, and one-fifth in error. This will be better seen by the following percentages: 79.3 correct; 17.4 slow; 2.5 fast; .8 stopped.

Of the meters found registering against the company, 551 of the number, or 40 per cent., varied from 2 to 7 per cent.; 713, or 54 per cent. of the number, varied from 7 to 17 per cent.; and 54 of them, or 4 per cent., varied from 17 per cent. to more than twice as much as the meter registered. While 46 were found that passed gas without registering anything. Of the 193 meters found registering against the consumer, 179 of the number, or over 80 per cent. of them, varied from 2 to 10 per cent., and 14 of the number varied from 10 to 25 per cent.

Col. Armington moved that the paper be received and placed on file, and that the thanks of the Association be tendered to Mr. Sherman, which was passed.

Theory of Luminous Flames.

Dr. Karl Hinmann has published an elaborate discussion on this subject, in which he concludes that the theory of Davy must be altered, but need not be replaced by a new hypothesis. From a discussion of the work of previous observers, and a variety of experiments on the diminution and restoration of luminosity in hydrocarbon flames, and on the distance between flame and burner, he arrives at the following conclusions.

(1.) The fact that a gas flame does not rest upon the burner, nor a candle-flame upon the wick, as also the fact that a flame never directly touches a cold body held within it, is to be explained by the cooling action exercised upon the gas by its surroundings. The combustible gases are cooled throughout a definite space below their ignition-temperature; the flame is therefore extinguished. This conclusion is opposed to that of Glochmann.

(2.) The very considerable distance noticed between the burner and the flame of a gas issuing under high pressure, or mixed with a large column of an indifferent gas, cannot be accounted for on the grounds put forward by Bonevides. The production of such a distance is much rather to be traced to the cooling action of the stream of gas and of the outer air, and perhaps more especially to the fact that the velocity of the stream of gas in the neighborhood of the burner is greater than the velocity of propagation of ignition within the gas.

(3.) In order that other circumstances conditioning the effect may be removed, the velocity of propagation of ignition must be equal to that of the gas-stream at the point, situated some distance from the burner, where the flame begins.

Determination of the velocity of ignition should be made under these conditions for different gases, and since this magnitude is a function of the difference between ignition and combustion temperatures, conclusions may be drawn from such experiments regarding the relations existing between these points.

(4.) The velocity of propagation of ignition may be easily determined for solid and liquid combustible bodies; and the numbers so obtained may be regarded as comparative quantitative expressions for the liability to ignition of these substances.—*Am. Jour. of Science and Arts.*

Sensitive Flames.

Mr. R. H. Ridout has devised a form of burner by which great sensitiveness is attained at very low pressures, and thus the principal difficulty ordinarily experienced, of maintaining a high and constant pressure, is avoided. A glass or metallic tube, about five inches long, and five-eighths inch diameter, is closed at one end with a perforated cork, through which slides a piece of one-eighth tubing about six inches long. One end of this is either drawn out to a jet or closed in the blow-pipe flame to reduce its diameter to about one-sixteenth inch, and the other end is connected to a gas supply. The outer tube is held in a suitable support, and the inner tube is pushed through the cork till it nearly reaches the mouth of the outer one, and a light is then applied. It now gives a long steady flame which is easily rendered sensitive by lowering the inner tube. Several effects are described which may be shown by it at any pressures above one-tenth inch of water.

A second arrangement is figured, in which two parallel vertical tubes are connected by a horizontal tube in which a drop of water is placed as an index. A very slight excess of pressure is shown by the motion of the drop to one side or the other. Allowing gas to flow through both tubes and lighting either jet the water will move toward the other, showing that the effect of the combustion is to obstruct the flow. Similarly it may be shown that a sensitive jet produces a greater resistance when its length is shortened by a noise or musical note. This effect may also be shown whether the jet is lighted or not.—*Amer. Journal Society of Arts.*

On the Volumetric Determination of Sulphur and Ammonia in Illuminating Gas, with a Description of the Apparatus Employed.

[A paper read before the American Institute of Mining Engineers at the Philadelphia meeting, October, 1876.]

By H. E. SADLER and B. SILLIMAN, of New Haven, Conn.

[Continued from page 106.]

VOLUMETRIC ESTIMATION OF THE SULPHUR.

Having so far demonstrated the efficacy of the new apparatus, the Letheby test was discarded, and the determinations of the sulphur hereafter given were made by precipitating the sulphur in the drip from the new apparatus by barium chloride, in the manner already described. The apparatus was not changed, except to introduce the tube *d*, to arrest the ammonia which, previously passing through the flame in undetermined quantities, had vitiated the volumetric estimations of the sulphur acids by standard alkali solution. The alkali used was caustic soda. For the scrubber, standard sulphuric acid was chosen on account of its slight volatility, and in order that the absorption of acid vapors by the gas, then deemed possible, might not complicate the results by introducing a new acid into the products. To saturate the alkali in the drip, standard hydrochloric acid was chosen, as it permitted a gravimetric estimation of the sulphur in the portion taken after it was titrated, avoiding alternate sources of error, either the estimation of the total sulphur introduced with the sulphuric acid, or obtaining two separate portions of the drip, having in solution exactly equal quantities of acid and of sulphur. Moreover, though free hydrochloric acid is somewhat volatile in boiling solution, experiment demonstrated that, with the degree of dilution and heat employed in these determinations, the loss was inappreciable. A 100-c.cm. pipette, and a burette measuring 200 c.cms. by tenths, were used for supersaturating the alkali with acid, and a 25 c.cm burette graduated to tenths for titrating back with the soda. For each determination a portion of the drip resulting from the combustion of from 6 to 10 feet of gas was taken, divided into two measurably equal portions, and duplicate experiments carried through, as shown in the following table, the results being calculated to grains in the 100 feet:

It will be seen by comparing columns III. and IV. that the acid caught indicates the quantity of sulphur in the gas with tolerable accuracy, sufficient for all manufacturing purposes. Columns V. VI. give the excess of acid and sulphur in terms of grains of sulphur per hundred feet. The average error in favor of the acid is 1·29 grains, and in favor of the sulphur, 0·75 grains, making the average total error 0·27 grs. in favor of the acid. Assuming this as a constant quantity which, being deducted from the acidity found, gives the sulphur, we have as a limit of error in favor of the sulphur (No. 4) 2·03 grains, in favor of the acid (No. 18) 1·89 grains. We may say, then, that one grain to the hundred feet is the average error, and two grains the limit of error for the volumetric determination of the sulphur in gas by this apparatus.

THE FORMATION OF NITROUS ACID AND OTHER SOURCES OF ERROR.

In endeavoring further to reduce or eliminate this variation, the drip from the condensation tube was carefully tested for other acids and bases. Besides the soda and sulphuric acid, nitrous acid, probably mixed with nitric, was detected by silver nitrate, and also on setting free the nitrogen acids with sulphuric by the coloration tests, ferrous sulphate, brucia, etc. No other acids could be found—carbonic, of course, excepted. The absence of sulphurous acid or a soluble sulphite was a surprise. It was demonstrated by precipitating duplicate samples, oxidizing but one of them. The resulting precipitates did not differ sensibly in weight. This fact was further confirmed by adding 10 c.cms. of carefully titrated solution of potassium sulphite to successive equal portions of the the drip. On titrating back with with standard iodine solution and starch paste, it was found that 5·65 c.cms. of the sulphite in each solution had been oxidized. Of the bases a trace of ammonia was alone found. The drip in experiment No. 12 was submitted to Nessler's test, and showed 9-10 grain of ammonia per 100 feet, equal to 84-100 grain of sulphur. The

No. I.	Date. II.	Acid caught per 100 feet expressed in grains sulphur. III.		Grains of sulphur caught per 100 feet. IV.		Excess. Acid. V.	Excess. Sulphur. VI.	Excess of acid corrected VII.	Soda, c.cms. per ft of gas burned. VIII.	Ref. burn in 100 minutes. IX.
	Aug.									
1	22–3	(38.55) (38.65)	38.60	39.34	39.34	.....	0.74	—0.74	7.90	1.064
2	23	(46.91) (46.58)	46.74	(41.33) (41.42)	41.37	5.37	.....	(—0.10)	9.75	1.026
3	23–4	(35.99) (35.93)	35.96	(35.28) (34.76)	35.02	0.94	.....	+0.94	12.28	1.023
4	24	(30.55) (31.25)	30.90	(33.95) (32.46)	33.20	.....	2.30	—1.21	13.67	1.056
5	24–5	(35.28) (36.01)	35.64	(34.48) (32.60)	33.54	2.10	.....	+0.6[illegible]	10.65	1.041
6	25	(36.61) (35.95)	36.28	(34.55) (34.23)	34.39	1.89	.....	+1.89	12.80	1.026
7	28	(34.20) (34.29)	34.20	(35.50) (35.37)	35.43	.....	1.23	—1.23	9.44	1.035
8	29	(38.98) (38,98)	38.98	(39.53) (39.62)	39.58	.....	0.60	—0.60	11.70	.996
9	30	(36.01) (35.68)	35.84	(35.80) (35.22)	35.51	0.33	.....	+0.33	13.33	.984
10	30–1	(33.27) (32.91)	33.09	(32.25) (31.96)	32.11	0.98	.....	+0.98	9.90	10.22
	Sept									
11	31–1	(33.63) (33.79)	33.71	(34.38) (33.86)	34.12	.....	0.41	—0.41	10.87	.987
12	1–2	(35.84) (35.54)	35.69	(33.91) (33.74)	38.82	1.87	.....	+1.87	9.95	.988
13	2–3	(34.87) (35.00)	34.93	(33.06) (33.06)	33.06	1.87	.....	+1.87	10.99	.966
14	3–4	(31.92) (32.58)	32.25	(31.40) (31.44)	31.42	0.83	.....	+0.83	10.79	.944
15	4–5	(31.90) (32.07)	31.98	(30.09) (30.30)	30.20	1.78	.....	+1.78	10.20	.957
16	5–6	(26.03) (26.51)	26.27	(26.46) (26.91)	26.68	.....	0.41	—0.41	9.65	.940
17	6–7	(24.81) (24.81)	24.81	(24.36) (24.33)	24.35	0.46	.....	+0.46	10.47	.943
18	7–8	(22.36) (22.36)	22.36	(20.12) (20.27)	20.20	2.16	.....	+2.16	13.19	.897
19	8–9	(18.43) (18.44)	18.43	(18.92) (18.93)	18.92	.....	0.49	—0.49	10.75	.960
	Average errors.....					1.29	0.75	.....	.....	.....
	Average total error.....					0.27	.....	.....	.....	.....

nitrogen acids were not determined, as no means for the estimation of so small quantities presented itself, except the somewhat difficult combustion process. It seemed impossible* that more than 1-100 grain of ammonia could be supplied by the 700 feet of air admitted by the apparatus for the combustion of 100 feet of gas, and it followed that the remainder must be produced in the burning. There was no other source for the nitrogen acid.

We are brought here face to face with a curious phenomenon. Nitrogen, forming simultaneously under the same conditions, an acid and a basic radical with the oxygen and hydrogen directly or indirectly supplied by the air and gas respectively.

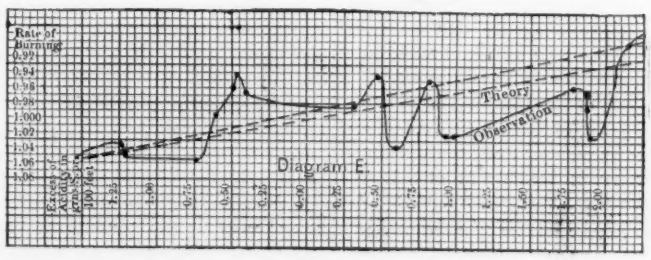
This fact has been before noted and more clearly proved.† Two theories present themselves in this connection to account for the variations noted in the above table between the sulphur and the total free acids produced by the combustion. The first is that where the gas is passing rapidly and the flame is near the smoktng point, the nitrogen will find an abundance of hydrogen from the gas and a scanty supply of oxygen. The tendency will then be to form ammonia in excess of nitrous acid. When, on the contrary, the gas is burned slowly and the supply of air being the same, a surfeit of oxygen awaits the scanty hydrogen, acid will be more freely formed than ammonia. The excess of total acidity will then be a function of the relative supply of gas and air, and column VII. will follow column IX., which gives the rate. How far our experiments sustain this view will be seen from diagram E.

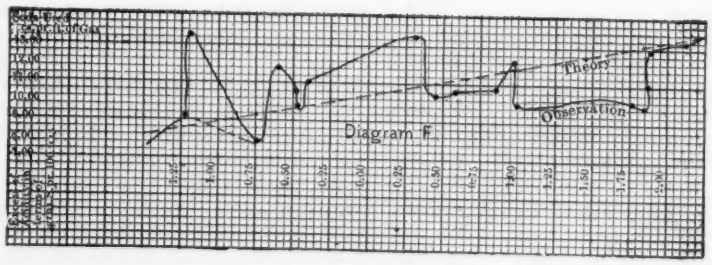
The second theory plants itself upon the hypothesis of the dual nature of nitrogen gas, one atom of each molecule broken up in nitrification taking to itself hydrogen and the other oxygen. In this case an excess of acid or base from the nitrogen is impossible, the product of nitrification being uniformly ammonium nitrite, a salt. This substance, however, is very unstable, falling readily back to water and nitrogen and yielding easily to an acid, ammonia, to a base, nitrous acid. Thus, this body, in passing through the condensing tube, would surrender its acid to the soda in amount somewhat proportionate to the quantity of free soda in the tube, while the ammonia, but slightly absorbed by the alkaline solution, would pass off at the escape. Column VII. would then accord in some sort with column VIII., which gives the relative proportion of soda and gas used in each experiment. Diagram F shows the variations.

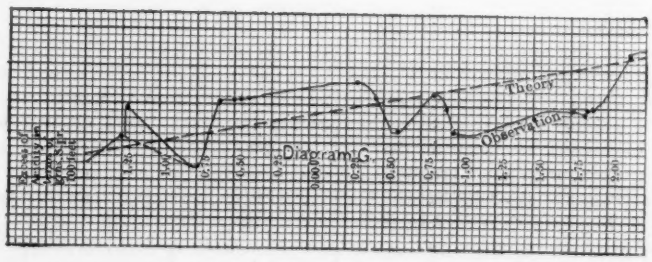
To pronounce upon the accuracy or sufficiency of either proposition without further experiments made with especial reference to them would be premature. Probably outside of certain limits which we may call the normal working, both the rate and the alkali used have their influence on the result, as will appear more clearly by comparing the two curves given above with the curve of their average as shown in diagram G.

For the rest the peturbations must be charged to the inaccuracy of the test as worked, of which there are several sources which, though small in themselves, may yet be considerable in the aggregate. First, we assume that, at the end of an experiment, the condensing tube contains the same quantities of alkali and of sulphur as at the beginning. The difference, when compared with the total quantity, must be small, but a difference there may be. Second, the alkali pipette attached to the apparatus, the acid pipette and burette, and the alkali burette must be strictly accurate; at least they should accord with themselves and each other. The former of these conditions was not in our apparatus entirely fulfilled. Third, the opportunity for error is considerable in judging the change of color with cochineal, especially when the determinations are made on different days and cannot be compared with each other; and, lastly, the "personal error" cannot be entirely disregarded.

[To be concluded.]







* See Johnson's "How Crops Feed," p. 55, and especially Viele's determinations. Pelouze and Fremy I, 320

† Shaeffer, Am. Jour. Sci., Nov. 1863. T. Sterry Hunt, Chemical and Geological Essays. Appendix p. 446. Shonbein London and Edinburgh Philos. Mag. June, 1863, p. 466.

The Manufacture of Coal Illuminating Gas.*

By Alfred P. Trautwein, M. E.

Continued from page 108.

We will now revert to our description of the details of the holders.

For the purpose of guiding the holder in its motion, a series of grooved rollers are provided at its lower edge, working against guide bars in the sides of the holder tank. Similarly, the upper edge of the holder is guided and steadied by means of a number of turned grooved rollers attached to adjustable carriages, and working against as many guide columns. When the holder is telescopic it is necessary to provide a set of double rollers and carriages on the top of the cup of the outer or lower section; one of these is placed opposite each guide columns, and they consist of a grooved roller working against the guide bars of the column, and of a barrel roller which serves to guide the inner section.

The guide columns already mentioned serve the additional purpose of supporting the weights and their chains and suspension rods, by means of which the holder or more generally its lower section is counterbalanced to any desired pressure. These columns are distributed at equal distances in the circumference of the holder tank to which they are firmly bolted. In their design engineers have displayed considerable variety; sometimes they are single cast iron columns or are composed of a number of shorter columns placed generally two or four in each section, thus giving the structure greater stability; frequently the columns are composed of boiler iron cylinders riveted together in sections, thereby greatly reducing the cost, which in the cast iron column is quite considerable, from the fact that all joints must be planed or turned; in several instances in this vicinity, finally, the columns are replaced by a light wrought iron triangular frame work. The tops of the columns are connected successively by means of wrought iron lattice or open cast iron girders. The guide bars against which the several rollers work are planed; the chains of the counter-weights pass over large pulleys at the tops of the columns. The holder must be provided with man-holes in the crown, with inlet and outlet pipes complete with their valves, drip-boxes, and pumps. But little requires to be said in connection with the

GAS HOLDER TANKS.

Where the nature of the soil permits, the tanks are generally built of brick or other suitable masonry, laid in good hydraulic mortar and well puddled over on the outside, in order to make them perfectly water tight. The sides should have a suitable batter to be able to withstand the pressure of the water within; a number of piers should be provided upon which the guide columns rest; the top of the walls should be capped with a heavy coping stone. The bottom of the tank is composed of brick laid flat on a bed of concrete; a number of footing stones are provided at intervals upon which the lower edge of the holder may rest. When the holder is down the main king post of its roof truss rests upon a pier of masonry in the center of the tank; where the soil is suitable for that purpose a mound in the center may perform the same duty, the cost of excavation also being thereby reduced. In Great Britain, within the last few years, several gas-holder tanks have been constructed entirely in concrete, and it is claimed that such tanks are not only less expensive but also are less liable to leak.

HOLDER HOUSES.

Occasionally holders are met with which are completely housed in, for the purpose mainly of protecting them as well as their contents from the influence of the weather. In this vicinity the holder of the Nassau Gas Works, Brooklyn, E. D., is covered in this manner, while several instances exist in the Eastern States. This, however, is not necessarily confined to small holders, and among others the holder house of the Providence (R. I.) Gas Works deserves a pass

ing notice from the fact that its wooden roof—a perfect dome—is, in diameter, the largest dome, but one, in existence. Before concluding our remarks upon holders in general, we will devote a few words to their sizes. In the single lift holder the capacity, as already stated, is limited; by making holders telescopic, however, their dimensions may be increased enormously; thus many holders have been constructed, particularly in and about London, with a capacity of one million and one and a half million cubic feet, and in at least one instance, if we remember correctly, a holder was built to afford storage for two millions of cubic feet of gas. The largest holder which has thus far been constructed in this country is that located at Point Breeze, Philadelphia; next in capacity are the two holders, Nos. 7 and 8, at the New York Gas Works; the latter, but recently completed, stores, as also does the former, 1,500,000 cubic feet, its diameter being 168 feet, with a total lift of 70 feet.

HOLDERS FOR PROJECTED WORKS.

In determining the capacity of the holder or holders for our particular case, it was deemed advisable to take into consideration several elements. Strictly speaking, the holder capacity of any works might be made dependent upon the nature of the consumption. The capacity of the works being given, as also the maximum quantity of gas required during a definite length of time, it is an easy matter to determine how great a holder capacity it is necessary to provide, in order that the supply may meet the demand during the period of maximum consumption. Such a course, however, would leave the manager with little or no gas on hand in the event of an accident to his gas producing plant, and it certainly will always prove to be a source of anxiety and of annoyance to him. For these reasons it is generally considered desirable to provide a holder capacity at least equal to the maximum daily capacity of the retort-house; if, under the circumstances, an accident does occur an adequate supply of gas will be at disposal, sufficient to meet one day's demand in winter and not less than two day's consumption in summer, thus generally giving the manager ample time to make good the damage, provided that it is not too serious. The holder, it is true, is a most important part of the plant, but, on the other hand, it forms one of the largest items in the cost of construction; very few works, therefore, are provided in the outset with the holder capacity in question. Wherever possible, however, this should be attended to; in the projected works, then, it is proposed to provide a storage capacity for 500,000 cubic feet of gas. In order to obtain this, we might employ one holder since, with the same aggregate capacity, two or more holders occupy more ground and necessitate a greater expenditure for excavations for the tanks, while in addition to this the cost of the iron work is much greater. Engineers, however, generally regard it advisable to provide at least two holders mainly as a matter of convenience to the manager, who at times is thereby relieved of much anxiety. In our particular case, as we shall subsequently see, such a course, also, is demanded by peculiarities in the nature of the gas supply to the town in question. The desired storage capacity, therefore, will be afforded by two holders, each of 250,000 cubic feet capacity. They will be telescopic in two equal lifts and of the following dimensions:

Inner or upper section: 86 feet in diameter. 21 feet inches in height.

Outer or lower section 87 feet 6 inches in diameter, 22 feet 3 inches in height.

Rise of crown: 5 feet.

Hydraulic cup: 15 inches in depth, 6 inches in width.

We will now proceed to determine the pressure which these holders are to exert, and to this end several elements require to be taken into proper consideration. We assumed in the outset that the most eligible site for the projected works is a point located some ten or eleven feet above the lowest part of the town, the difference between twe extreme levels being 28 feet. Now, the pressure which is required in supplying the lower sections of the town is somewhat greater than that which is demanded by the high level service, assuming the nature of the gas supply in both cases to be the same, of course, in every respect. It is very convenient that we have two holders at our disposal, since it is proposed to divide the city into two districts, the high and the low level, thus enabling us to employ one holder exclusively for the high and the other for the low pressure service; by adopting this course the requirements of the projected gas supply are fulfilled in a manner as nearly perfect as the circumstances will permit.

The holder pressure, then, depends upon the nature of the consumption; it is determined, therefore, by the amount of gas to be supplied and the distance to which it must be carried, and consequently is largely influenced by the size of the distributing mains. In addition to the pressure which the gas supply proper demands, it is necessary to provide for a certain slight pressure under which, at least, the gas should arrive at the most distant point of consumption, this being essential to ensure its combustion in a most thorough and advantageous manner.

For want of the data requisite in this direction we will assume that the gas supply in our case will be effected satisfactorily by providing a pressure of three inches of water. It is proposed, therefore, to proportion the holders in such a manner that the minimum working pressure of each will be three inches, and the maximum four inches on a water-gauge.

The working pressure of a holder, evidently, is the pressure which is capable of sustaining a column of water whose height in inches equals the difference between the water levels inside and outside the holder. It is determined, therefore, both by the weight of the holder and by its area of water surface; the latter being given, it becomes necessary to so arrange the weight of the holder, that, when in its lowest position, the pressure which it is capable of exerting upon the gas shall equal three inches of water. To this end it is obviously simply necessary to calculate the weight of a column of water whose base equals the area of water surface of the holder, and whose height equals the working pressure in inches; or, putting this remark into another form, we have the following formula for determining the weight required to produce any desired pressure:

$$W = 5.2\ Ah, \text{ in which}$$

A is the area of the section of the holder in square feet,

h, the given pressure in inches on a water-gauge,

5.2, a constant, being the weight of a column of water one square foot at the base and one inch in height, and

W, the weight of the holder in pounds.

In our case, therefore, the upper or inner section of each holder, for a working pressure of 3", must have a weight of 90614 lbs. It is hardly necessary to remark that this is the absolute weight of the holder; apparently, this is diminished somewhat by the fact that the sides, being immersed in water, are subjected to a loss equal to the weight of water displaced. The working pressure is thus slightly reduced; at the same time still another element enters in this relation, namely, the levity of ths gas or the buoyancy which it exercises on the top of the holder, and which has a tendency to diminish its absolute weight. The reduction in pressure, however, is generally quite insignificant, and though the necessary corrections may readily be made, the above sources of error are usually not considered in practice.

On the other hand, this deficiency in the working pressure is more than equalized by the additional pressure which is due to the water contained in the hydraulic cup of this section. The interior dimensions of the cup have already been given: 15 inches in depth and 6 inches in width, and it consequently contains about 10,600 lbs. of water, which will increase the working pressure by about

$$h = \frac{W}{5.2\ A} = .35 \text{ inches.}$$

The remainder of the required pressure, one inch of water, must be secured by means of the outer or lower section, and for this reason its weight must be 31,269 lbs. The total actual weight of this section, no matter how light the sheets, ribs, etc., may be made with a due regard for strength, is, however, somewhat greater than is necessary to produce the desired pressure; this part of the holder. therefore, must be suitably counterbalanced, while at the same time the diminution in pressure due to the loss of weight by immersion, may be counteracted by properly proportioning the weight of the chains and suspension rods.

The distribution, in the holders proper, of the weights given above as requisite for the desired working pressure as well as the design of the details, in general, of the holders, guide frames, and tanks, constitute a special problem which we cannot very well afford to take up in this connection.

STATION GOVERNOR.

The pressure which is exerted by the gas-holders at any time depends, as we have seen, upon their height above the water level; the consumption of gas varies, of course, continually, and in most cases is quite insignificant during the greater part of the day. It is not necessary, therefore, to maintain during this time so great a pressure in the distributing mains as is required during the hours of maximum or even average consumption; at the same time such a course is rendered absolutely necessary, if it is intended to keep within reasonable limits, the percentage of leakage, already quite considerable even under the most favorable circumstances. The pressure in the mains, therefore, must be adjusted from time to time to the lowest minimum compatible with the desired supply.

These fluctuations in the consumption and pressure occur so rapidly and so unexpectedly, that the release of the gas from the holders must obviously be effected by means of some apparatus which does not require constant attention, and which shall perform its duty both rapidly and automatically. This is accomplished by the use of the station governor, which was one of the earliest and most important inventions of Samuel Clegg.

In its original form this governor consisted of a small holder which, being actuated by a small stream of gas from the outlet pipe of the governor, worked an ordinary hydraulic valve by means of a beam counterbalanced to any desired pressure; the whole very much resembled the exhaust governor already described. The slightest irregularity in the consumption, therefore, produced a corresponding variation in the pressure in the governor holder, thereby affecting the valve. This device, however, was soon superseded by one in which the desired regulation in the flow of the gas was effected by means of a conical valve of some length, attached to and suspended from the crown of the holder and working in the inlet pipe of the governor, thereby rendering the action of the instrument more delicate and more certain. One, or generally two, counterbalance levers enabled the necessary adjustment to be made.

This form of governor has variously been modified, and a large number of minor improvements in its details have been introduced; but although it has received a vast amount of attention, while much ingenuity has been displayed in its design and construction, yet the station governor in general use at the present time does not materially differ, in principle at least, from that which has just been described.

The object of the station governor is to give, under a varying initial, a constant outlet pressure with a variable delivery, and consequently all of the changes referred to above were devised, with a few exceptions, with a view mainly of attaining this desideratum. One of the most important of these, no doubt, was the substitution for the conical valve, of one having approximately a parabolic section; in this manner the release of the gas is effected much more uniformly and with greater nicety. The relative proportions of the valve and the inlet pipe in which it operates, vary between very wide limits in the prantice of different engineers, as also, and to an evec greater extent, does the ratio between the length or

depth and the diameter of the valve proper. Bearing in mind the laws governing the efflux of gases through contracted orifices, it will readily be admitted that the opening for the valve may be somewhat smaller than the inlet pipe itself, and in the practice of several eminent English authorities, the maximum opening of the valve equals one-half the area, while the length of the valve equals one-half the diameter of the connections.

The most essential of the several characteristics of a good station governor is, without doubt, its sensitiveness or the promptness and accuracy with which it equalizes the rapid and continual fluctuations in pressure und supply. On the other hand, it is not advantageous to carry this much beyond a certain limit, since any further increase in delicacy in the action of the governor is then obtained only by sacrificing to some extent its steadiness; governors, indeed, are occasionally met with so peculiarly liable to sudden oscillations under varying rates of consumption, as to be the source of constant trouble and anxiety particularly from the fact that, when once they commence the vibrations continually increase in amplitude. In the majority of cases this peculiar action may be traced directly to a deficiency in the area of the holder as compared with that of the bottom of the valve; and it may be stated, as a general rule, that those governors are to be preferred, in point of facility in maintaining a steady pressure, which have comparatively the greatest holder area; it is not necessary to point out the reason for this since the first glance at the nature of the pressures which act on the base of the valve and the crown of the holder will render it quite evident.

The few rules for proportioning a governor which are in existence are so entirely arbitrary, that many engineers regard them as being of very little practical value; it has been found. however, that a sufficiently high degree of delicacy and, at the same time, also of steadiness in the action of the instrument may be expected with some certainty, when the area of the holder is made from fifteen to twenty times that of the bottom of the valve and this, we may here remark, is demanded by the most approved and recent English practice.

Generally speaking, very few of the various kinds of station governors in common use can be said to be free from the liability to pulsation referred to above. In England, however, where a great deal of attention has been bestowed upon the subject at issue, several governors have been designed which are practically perfect in this respect: in one instance this was accomplished by removing the pressure on the bottom of the valve, thereby eliminating one disturbing element; in several governors which seem to meet with great favor, the pressure on the valve is equilibrated by means of a separate small holder, having an area equal to that of the valve and subjected to precisely the same pressures as the valve. All of these devices, however, attained the desired end only at the expense of simplicity—a cardinal quality in every instrument of this kind—and consequently, as previously stated, their use is the exception rather than the rule. In this country the ordinary form of governor already described, but with a number of slight modifications has genecally been found quite satisfactory; some engineers, however, both here and abroad, have rejected the use ot the parabolic valve, and have substituted for it a plain throttle valve in the main, and actuated by the holder through the aid of a series of levers. The duty of the station gonernor has already been defined as consisting in the maintenonce, when once adjusted for a given pressure, of this pressure at a uniform figure no matter how great the fluctuations in the rate of consumption may be. In proportion, however, as the consumption falls off, the pressure in the mains should be diminished, and consequently the governor must be adjusted, generally half-hourly, during the early part of the evening, and at longer intervals in the course of the night. To obviate the necessity of doing this, a very neat piece of apparatus was recently introduced in one of the gas works in his vicinity, and in which the desired adjustment is made entirely automatically; the counterbalance weight in this is constant, and is gradually moved along its lever by means of a cam or template rotated by means of clockwork, thereby increasing or diminishing its leverage upon the holder, and consequently the pressure, in a manner determined by the outline of the cam.

The engineer is rarely called upon to design the station governor, it being like the station meter a standard article of manufacture, and the above discussion of its principles and its construction was introduced with a view merely of indicating the direction in which it would probably be necessary to look for a good and efficient station governor.

The governor house of the works is generally located at or near the holders; it should be provided with a pressure gauge to be employed for the adjustment, with a pressure register, for recording graphically the pressure in the street mains and finally, the connection for the governor of each holder should be so arranged as to form of bye-pass.

Before permitting the gas to leave the works for distribution, it should be tested once more as to its illuminating power, and it would be well also to note whether it contains any traces of impurity, readily perceptible by means of test papers, which might prove deleterious when the gas is burnt. It is too late, of course, to remedy any short-coming in these respects at this point in the process, but these observations, when frequently made, will enable the manager to take the steps necessary to prevent the recurrence of such a deficiency; at the same time these records might be of value in case of complaints on the part of the consumer or the authorities, and, if carefully and faithfully kept, they cannot but prove to be data of interest and of immense value to the manager himself. In most of our larger works great care is devoted to these observations, and the work is intrusted to experienced chemists; in such instances it is generally customary to determine the impurities in question, not merely qualitatively but also quantitatively, at frequent intervals, and by the aid of methods and apparatus, involving every element of accuracy and dispatch, which modern science could suggest.

Any attempt, however, to describe and discuss, even in a very cursory manner, the numerous and excellent apparatus and methods which the combined and constant efforts of both the chemist and the physicist have placed at the disposal of the manager would certainly not merely prove unsatisfactory, but would also extend this paper far beyond a reasonable limit. We will be compelled, therefore, to confine ourselves to a brief enumeration of the apparatus and instruments with which the photometer room apd the manager's office in every well regulated gas works should invariably be provided.

In the pholometer room these are, first and foremost, a Lowe jet photometer in one of its numerous modifications, and which is preferably used in conjunction with the more accurate but, at the same time, less convenient Bunsen Bar Photometer which, too, has variously been improved or otherwise modified. Secondly, one at least, of the saveral apparatus for determining the specific gravity of the gas, which has been found to serve as a ready check for the accuracy of the photometrical observations, a striking relation appearing to exist between the density and the illuminating power of coal gas; and the apparatus due to Bunsen and based upon the laws of effusion of gases through minute orifices, is sufficiently accurate for this purpose, while its manipulation is more simple and more rapid than any other method, the gravimetric method for instance

For the manager's room it would be well to provide the instrument known generally as "Young's Sulphur and Ammonia Test," or some other ready means of indicating qualitatively the impurity in the gas. Pressure guages, connected with several of the more important parts of the works, would enable the manager to observe at a glance the slightest irregularity which might occur at his works, thereby locating it sufficiently to enable him to check it immediately. A pressure register, similar to that in the governor house, would certainly prove useful, as also would a pressure and Vacuum Register, for recording graphically all fluctuations, if there be any, of the pressure in the hydraulic main, thus serving as a check upon the exhauster.

[To be concluded.]

Notes on the Masonry of the East River Bridge.

[A Paper by Francis Collingwood, C. E., Member of the Society. Presented November 1st, 1876.

[Continued from page 10 .]

11th. Method of Erection—When the timber courses in the foundations were completed, 3 setting derricks were erected, one near the center of each shaft. These had masts of 56 feet height, with cross-booms 35 feet up, and strong back-stays to take the thrust. The booms were horizontal, with a buggy traversing their length, so that the derrick commanded the entire area of a circle of about 35 feet radius.

In Brooklyn, permanent hold backs (dead men) were used for guying to; the system of guys being rectangular, and the three derricks being connected by sky-guys. This required a constant tightening of guys during the sinking of the caisson. In New York, the guys were attached to the top of heavy inclined struts 40 to 45 feet long, by eye-bolts with long screw threads for adjusting. The struts were double, with a cross head of oak. On each side of the bolt for the sky-guy was another bolt for connecting the holding down rods; these were finally anchored to heavy screw bolts in the timber below the masonry. The struts used at first had a spread of 6 feet at the base, and the rods, of 3 feet. As the work advanced and the rods were lengthened, this was found to lack in stability, and the spread was increased to 9 and 6 feet respectively.

In computing the dimensions of temporary iron work in detail, a load on wrought iron, of 10 tons was always assumed and maximum strains of 8 tons per square inch allowed; the best Ulster iron being used, and for guys, steel or iron ropes.

For derrick falls, Manilla rope of best quality (4½ inches circumference), was always used; and no rope allowed to be used after it became seriously chafed by wear.*

But two serious failures have occurred with these derricks. The first was by splitting of a cast iron rope socket on a back stay, when lifting a very heavy stone. On investigation it was found that the sockets were too light for the work; and a heavier pattern was made which fully met the difficulty. The second failure was from an unsound weld in the eye, of a closed wrought iron wire rope socket. The open or two-jawed sockets have since been adopted, as being safer, and free from any such danger. This socket was also on a back stay.

With these derricks, a rise of masonry of 20 to 28 feet could be set without a change of position; small holes being left in the masonry at the points occupied by the derricks, which could be filled after the derricks were raised. The cast-iron foot-step of the derricks had wrought iron rings in top by which they could be withdrawn, thus saving their renewal.

At each successive rising, wrought iron brackets were inserted in the masonry, as supports for the feet of the derrick struts. By having the iron work prepared in advance, about one week was required for raising the 3 derricks on a pier, and about ten days 6 for the derricks on either anchorage. About 80 feet in height of the Brooklyn tower (above tide), and 120 feet of the New York tower, were thus laid.

As a hoist of 40 feet required 160 feet of rope to be coiled on the drum of an engine, it was found to be inconvenient to take more than this height for a single hoist; hence when this height was reached a tall derrick was erected at ground level, which raised all materials to a platform placed along the face of the tower. A railroad track on this, served for transporting the stone within reach of either of the setting derricks.

* No case of breakage of a fall ever occurred. Great care was always taken in leading a fall to prevent chafing. When possible, no leading block was put nearer to the drum than 20 feet, and the first blocks (which were usually permanent(were 18-inch iron sheaves lined with *metalline*, some of which have now been in constant use for eighteen months, with no perceptible wear. It has been found economical to turn the grooves of all sheaves, as a large saving in wear results from so doing.

In New York, at 80 feet height, a second track was built, and the hoist taken to this, from the ground by a gaff attached to the face of the tower. To accommodate the increased length of rope, a smaller drum was made for the engine, so as to avoid the increased leaverage caused by the extra turns.

The derricks used in unloading from the stone scows, and all those used at the stone yard, had the fall from the engine pass up through a hole in the center of the foot-step and spindle, and out along the inclined boom to a block at its upper end.

The disadvantage of these derricks for stone setting, is that they only act on the circumference of a circle, and require the boom to be raised or lowered, to reach other points. Most of these were arranged with two fixed inclined struts from the head of mast, for supports.

There were several failures of the derricks with inclined struts—all resulting from the upward thrust from the strut—*first*, from the breaking of the iron strap clasping the strut, at its head, (and in the end of which the derrick pin turns); and *second*, from the pin in head of mast being pulled out, (not being securely fastened). Another cause of failure was, the splitting of the foot-step; caused by the sides of the hole not being chamfered enough to allow lateral motion of the mast-head. In one case the pin at the mast-head, (2½ inches in diameter) broke square across, after about four years constant service.

All stones, were received, measured, assorted, and stored at the stone yard at Red Hook, where 15 derricks, and 3 steam engines were in constant use.

At each anchorage, 6 derricks similar to those used at first on the towers, were employed. The guying was in one system, requiring 7 sky-guys and 10 inclined guys, the load assumed being 8 tons, on each of 2 derricks hanging in the same direction; this load was very rarely if ever reached.

From the heights previously named, the tower were completed by the use of balance setting derricks, and a travelling crane; the stone being hoisted to them by a 25 horse-power (nominal) engine, link motion, geared to 2 heavy drums, carrying wire rope, of 1½ inch diameter. These hoisted the stone to, and through, an elevated platform, supported by scaffolding, and resting on the ground, and anchored to the masonry at about every 12 feet of height. The verticals of this scaffolding were compound beams each made up of 6 planks, and a center piece, all short; the planks broke joints regularly, were securely spiked, and through screw bolts placed at intervals. Each rope passed over a large wood lined sheave 4 feet in diameter, which was supported by a heavy oak frame securely guyed to the masonry, irons being inserted for the purpose.

The vertical support of each frame was a compound beam of 8 planks and a center piece. It was securely strutted and anchored to the masonry and the elevated platform. The platform and frames were raised ordinarily for every 8 feet rise of masonry. The drums were disconnected for this purpose, and enough rope unrove to allow of the increased height.

A wire rope backing line joined the hooks of the two hoisting ropes, so that as one was raised the other was hauled down by the line. As only one gang of masons worked on the tower, this was found to be all that was required, as the hoisting could be done faster than the setting.

The average speed of hoisting was from 1 to 2 feet per second, A greater speed was not desirable, on account of the difficulty in properly handling the tag line.

Owing to the great length of the inclined portion of the ropes, there was a tendency in them to take up a vibratory motion, synchronous with the strokes of the engine, and the engineers were always instructed to change the engine speed occasionally, to arrest this action.

A double engine with cranks at right angles, would, on several accounts, have been preferable to the one adopted, chiefly for greater smoothness of action in lowering. The jerks accompanying this, particularly when with a heavy load, brought severe strains on all the attachments; fortunately, the occasions when such loads were lowered were very rare.

The balance derricks on the towers had arms of equal length, and the balance weights used were sufficient to balance safely a load of 6 tons. When stones heavier than this were being handled, the balance end was chained down to stones already set, until the stone was run in far enough to be balanced by the weight. Struts under the booms were at time used in setting a heavy stone at the end of the boom.

On the Brooklyn tower these derricks were worked by small steam engines placed on them, and travelling around with them. The steam was brought up from the yard below in iron pipes, and carried to the engines in a rubber hose.

The travelling cranes were used only on the central shafts, and when interfered with by the arches they were replaced by balance derricks. The cranes traversed in two directions, so as to reach every point underneath, and they were supported by scaffolding similar to that for the elevated platforms. They are safer than the balance derricks, and more expeditious in use.

The engines used on the work, aside from those spoken of, were of two kinds. In the first, an end V friction on one end of the drum was used for throwing in gear, in place of a clutch; and the lowering was done by a strap brake at the other end of the drum. These work with entire safety, but the descent of a stone in setting could not be governed so well as with the other style, which had a clutch on the driving shaft for throwing in gear, and a strap brake on the drum for holding the load. Most of these had two drums, each worked by a cylinder 8 inches in diameter and 10 inches stroke.*

For all ordinary weights with fourfold purchase, 85 pounds of steam were sufficient: but for loads of 7 to 9 tons, steam was frequently carried at 100 pounds; particularly when the hoist was up to 80 feet. The lowering and setting (the second type of engine was used at the anchorages for this purpose) with these was done by shutting off steam, and opening to a greater or less degree a small escape cock, connected with the valve chest. With the descending load, the piston then acted as an air pump, and the speed of descent depended entirely upon the quantity of air allowed to escape.

12th. Arrangement of works.—From the very outset on this work, the fact that steam power is cheaper than hand labor has been kept steadily in view. At the stone yard, the 15 derricks mentioned were so arranged that all could be worked by steam, and a series of narrow gauge tracks were laid so that the stone could be brought to them on small stone cars with the least possible labor.

At the towers and anchorages, the permanent tracks were of ordinary gauge, 4 feet 8½ inches, and turntables and switches put in where required for convenient working. The advantages of the wider gauge were, greater freedom from danger of upsetting a car with a heavy load, and also in Brooklyn, the saving made by using the street car tracks for the distance of a block. Until the masonry of the New York tower reached high water, there were two tracks extended directly over the work to about the middle points between the derricks. These were suspended on canti levers, so as to be entirely free from the work below and proved a great convenience. The tracks to the anchorages were made double (except in Water street, New York, which was too narrow), and curves were put in, wherever observation showed that by so doing any obstruction of frequent occurrence could be avoided, such as trucks unloading at a bonded warehouse. On the New York side, the anchor plates, measuring 16 × 17½ feet and weighing 23 tons, were transported from the dock to the anchorage over these tracks. Each plate was suspended between two cars, on a simple frame work of timber about 30 feet long; the cars acting as bogies. The curves in the track, one of which was of 34 feet radius, were greased, and with two teams of horses, the plates were each hauled to the anchorage 1,000 feet distant, in from 1½ to 2 minutes.

13th. Accidents*.—As is sure to be the case, these always happen where least expected, and at some weak point which has been overlooked. A system of daily inspection of derricks was instituted at the start and kept up to the end of the work. This was entrusted to the foreman in charge of riggers, a man of large experience. Aside from failures already mentioned, there were several cases of straightening of hooks of blocks under heavy loads. These were in every case, only after long, continued use, and evidently after the iron had baen repeatedly strained beyond the elastic limit. In one case, with fortunate escape from serious consequences, a leading block on a derrick split. In another case the heel of an unloading derrick—frame-work and all—slipped on its bed. Several serious accidents, all the result of carelessness of those injured, occurred to men guiding falls on engine drums. One or more occurred from defective strap brakes; the woods having worn so as to prevent a proper tightening. One occurred from the careening of a balance derrick, owing to the improper removal of the blocking underneath; and one or two from overbalancing. It should be stated here that these derricks were raised 4 feet at a time, and supported on blocking, which was removed piece by piece as stone setting required.

The limestone first received was lewised with round lewises. These were found to be unsafe, but not until one or two serious accidents had resulted, by stone so lewised falling when swinging over the work. In all subsequent contracts, it was specified that flat lewises only should be used. The size adopted was such that the portion entering the stone had a united area for the 3 parts, of about 4 inches bottom width, 3 inches top width, and entering 4 inches into the stone, with a thickness of ¾ inch. These, when properly driven, never pulled out, with any hoist up to 80 feet. But when very heavy pieces of granite were taken to the upper portion of the tower, the surging would sometimes crack out a flake of stone, 1 to 2 feet wide. But one stone actually fell from this cause (from a height of 200 feet), but in several cases the flake came out, on removing the lewis, For this reason, a still larger lewis was used afterward on the heavier stones of from 9 to 11 tons weight.

Most of the serious accidents to men occurred from falling. One fell from a gang-plank by allowing his wheel barrow to pull him off, and several lives of men working on the towers were lost by a mis-step. The force of the wind near the edge of the work was often very great, and, coming as it did, in sudden puffs, it became a source of great danger.

14th. Signals.—At such a heigth as that of the towers, it was often difficult to make the men who were below understand signals from those above. This became a source of real danger in hoisting heavy stone, as the top of the tower was frequently enveloped in mist, so as to almost hide it from the engineer. The wind and other noises would often drown the voice, and at times a sharp whistle was heard but faintly. Bell wires were tried, but were so liable to become deranged that they were sometimes sources of danger. By great watchfulness, the cases of overwinding were rare, and no serious results followed. The safest signal was a flag, held well out, and the motions positively made, so as to be unmistakable if seen at all. A whistle was also used as an additional safeguard.

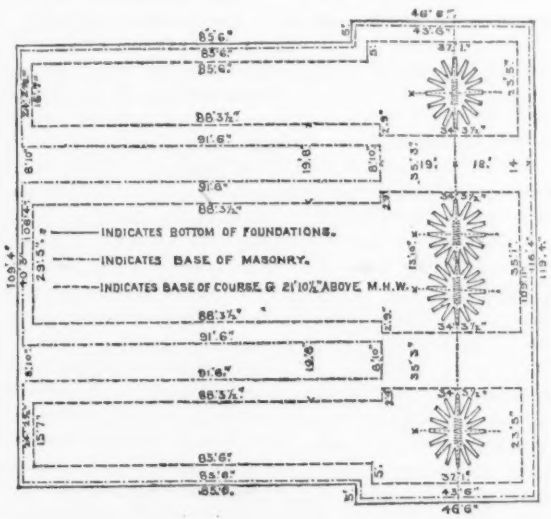
15th. Anchorages.—These rest on timber foundations, with the spaces between sticks, 2 to 5 inches, and filled with concrete. The extreme dimensions of the Brooklyn anchorage foundation are, 119 feet 4 inches by 132 feet. It is 4 feet deep, its base reaching to tide level, and the whole being constantly wet by water in the sand. The excavation was from 20 to 25 feet deep, and the foundation rests on a uniform bottom of fine sand.

* Most of the engines of this class in use on the work were made by Louis Osborne. South Boston, Mass.

* The term is used without regard to the injury done (it being in many cases very slight) the object being to point out the sources of danger on such work.

The New York anchorage has a similar foundation, 119 feet 4 inches wide, but extended at the front so as to be 138 feet long. This change was made on account of the character of the bottom across the front edge. The ground here had been filled in, and the excavation was continued until a uniform bottom of clean sand and gravel was reached over the whole surface. The foundation is all below tide, and has a depth of 4 to 7 feet.

The masonry of the Brooklyn anchorage, therefore, starts at 4 feet above tide, and that in New York at high tide level. The anchor plates in Brooklyn have their upper surface at 8 feet, and in New York, at 6 feet above tide. The general plan of the anchorages is here shown.



The walls, both outside and in the main tunnels, have a batter of ½ inch per foot rise, The exterior measurements of the cornice are 124 feet, by 111 feet 8 inches at rear, and 101 feet 8 inches at front. The main tunnels are arched over by semicircular arches of 23 feet span, springing at 62 to 66 feet above tide. The rear tunnels have vertical walls, and are arched by semicular arches of 14 feet span. These were not a part of the original plan, but were inserted to give means of communication from front to rear.

For 29 feet above tide in Brooklyn, and 22 feet in New York, the stones, except over the anchor plates, are all limestones, with rock face pitched to a line on the arrises. At these heights there is a 10 inch offset carried around all the faces except those of the rear tunnels, and above this the corner stones at each exterior angle are of granite. The corner stones have a bold chamfer, 4 inches broad, cut entirely around each face, except at the projecting corner. The faces between the chamfers have a draft 1½ inches wide cut around each, and the surfaces between, pointed to ½ inch prejection The limestone has the same finish throughout, as at first described. The cornices are of granite, corresponding in detail to those of the towers.

The New York anchorage contains 28,803, and the Brooklyn anchorage 27,113 cubic yards of masonry.

The anchor bars start from each plate in double sets, one curving over the other. They are vertical for about 25 feet, and then curve about 90°, so that the radius of a circle through the lower pins is 49 feet 6 inches. From this point, they extend to within 25 feet from the front edge of the masonry, where the cables are attached. The links of the first three sets have a section, 7×3 inches; the next three, 8×3 inches, and the next three, 9×3 inches. The tenth set is double in number, and each, 1½×9 inches. The total weight in each anchorage is about 1,000,000 pounds. At each knuckle of the chains a large piece of granite is set, with a heavy cast-iron plate inserted, as a bearing for the heads of the links.

Aside from these bars, there are heavy bars inserted for attaching the cradle and foot bridge cables, for attaching the wind guys, and minor irons for temporary work.

The work of excavating for the Brooklyn anchorage began February 15th, 1873. The foundation was completed, and the first stone laid, June 26th. Work stopped November 29th, at 27 feet above tide. The approximate cost of the season's work, for 8,334 cubic yards of masonry laid, was $18 per cubic yard, of which $13.34 were for stone.

Work began again June 11th, 1874, and continued until December 29th, reaching 61 feet above tide; it was again resumed April 6th, 1875, and was completed as far as practicable till after cable making, October 1st, 1875, a total of 24,132 cubic yards having been laid.

Work on the New York anchorage began about May 1st, 1875, and the first stone was set August 5th; work was closed December 11th, 15,067 cubic yards of masonry having been laid during the season, at an approximate cost of $14.50 per yard; of which $9.50 was for stone; work began again April 10th, 1876, and the masonry was completed ready for cable making August 31st.

Estimates have not been made up, for this season's work. The increased cost in New York for labor, etc., is due to the greater delays in handling material and to pressing the work, two gangs of masons being employed during the day and one at night, instead of one day gang.

Approximate estimates of the cost of the Brooklyn tower, as it stands, show that the masonry for labor and contingencies (or everything but materials used in masonry), costs per cubic yard, $7.84. This includes labor, foreman, machinists, watchmen, scaffolding, wear and tear, rent of stone yard, towing scows, coal, &c., and may be subdivided as follows:

Top of caisson to high tide, per cubic yard				$4 96
High tide to roadway, about	"	"		6.36
Roadway to springing	"	"	"	9.70
Springing to top,	"	"	"	12.60

Of this, the cost on the stone from the time it was laid alongside the dock, at Red Hook, until it was laid alongside at the pier, averaged $1.10 per yard. If we deduct this, from the cost of each portion as previously given, we get the relative costs (independent of cost of stone) of the various portions about as the following numbers:

Below tide	13
Tide to roadway	18
Roadway to springing	29
Springing to top	39

In other words, the first 80 feet above the roadway costs about one and one-half times as much per yard for labor and contingencies as the 120 feet from high tide to roadway, and the 72 feet above springing about twice as much.

The average cost of the stone used in the Brooklyn tower, delivered at Red Hook, was about $21 per cubic yard, varying all the way from $15 to $83 per cubic yard.

Excavation in the Brooklyn caisson, costs for labor only, including the men on top, about $5.25 per cubic yard. Running the 6 air compressors added to this, $3.60 per hour, or about 47 cents per yard; lights added, $0.56 more; and these with other contingencies nearly equalled the cost of labor. The great cost was due to the excessive hardness of the material over much of the surface; the caisson finally resting over nearly its whole extent on a mass of boulders, or hard pan.

The concrete in the caisson cost about $15.50 per cubic yard for every expense. The caisson and filling together aggregated 16,898 cubic yards; and the approximate cost per yard for every expense was $20.75. This was less than the cost of masonry laid in the open air.

The labor of making these estimates is very great; and it has not been done for the New York tower.

16th. Settlement of Masonry.—Bringing the account of the work up to the latest date, it is sufficient to say, in closing, that the settlement of the Brooklyn tower, at the time of completing the masonry (measured from marks at all salient angles, which were made immediately after the work reached high water), averaged 0.101 feet, the extremes being 0.08 and 0.102 feet. The average for the New York tower was 1⅛ inches, with a still closer correspondence, but the figures are not at hand.

The settlement of the New York anchorage from the time of reaching 22 feet above tide when the levels of all salient angles were referred to a permanent bench mark, was ¾ inch across the front, and 1¾ inches across the rear. The difference is no doubt due to the greater proportional weight at the rear. The figures for the Brooklyn anchorage are about the same, but are not at hand.*

* Photographs accompanying this paper, showing the Brooklyn tower and the New York anchorage in perspective, are deposited at the rooms of the American Society of Civil Engineers.

Gas-Light Intelligence.

United States.

If anybody has a patent gas burner which does not save at least 10 per cent. and give 20 per cent. more light, he is at present unknown.—*Telegram.*

Rock Island Gas-Light and Coke Co.–The works of this company have been purchased by Col. Wm. R. Garrison, Capt. J. R. Baby, and Sylvester Watts, Esq. Mr. Watts is to take the general management of the works, and the name of the new company is the "Rock Island Gas Co." The new company will at once lay about two miles of mains and build a new holder,

The Vicksburg Gas-Light Co.—At the annual meeting of the stockholders of the Vicksburg Gas-Light Co. March 15, Hon. R. O'Leary was called to the chair, and Mr. William B. Cleland requested to act as secretary. The annual report of superintendent Cleland was read, showing the company to be in a prosperous condition, with an increase of consumers and good prospects for the coming year, after which an election of officers was had, with the following result:

President—N. G. Bryson.

Directors—W. T. Balfour, D. W. Flowerree, Geo. M. Klein, William B. Cleland.

Secretary and Treasurer—Richard Richardson.

Superintendent—William B. Cleland.

And the meeting was adjourded.–*Vicksburg Herald, March* 15.

Crude Petroleum—The amount of crude petroleum produced each month during the year 1876 has been as follows:

January	712,225	July	763,623
February	668,885	August	782,223
March	718,177	September	780,600
April	701,490	October	809,162
May	735,351	November	786,480
June	723,600	December	787,090

Total for the year	8,938,906
Daily average	24,572

—*Polytechnic Review.*

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MONDAY, APRIL 2, 1877.

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—ED.

Gas Stove Accidents.

SYDENHAM, LONDON, March 13, 1877.

Mr. Editor: I beg to state for the last sixteen or seventeen years I and my family have used a gas bath, and never experienced any bad effects from the consumption of gas, although I must state that it is properly regutated (by a gas regulator) so that when turned full on, it will only consume the proper quantity, about equal to four burners consuming five feet each. I have no chimney in the bath room, but I have an air brick at the top of the room for ventilation. No one should use a gas stove, *or gas burners*, unless there is ventilation in the room,

Respectfully yours,
MAGNUS OHREN.

Country Laboratory Apparatus.

40 BEACH ST., NEW YORK, March 23, 1876.

Mr. Editor: I notice in your issue of the 16th inst. a paper entitled "Country Laboratory Apparatus," by Edmard T. Hardman, F.C,S., extracted from the *Chemical News*. Allow me to make a few remarks on Part II, in which he recommends the use of tobacco pipe for the estimation of the volatile matter in coal A much more simple plan would be to employ a light porcelain crucible of about one ounce capacity, which will readily hold one hundred grains of coal, and proceed thus:

I. Carefully weigh the crucible and cover.

II. Place the *uncovered* crucible containing 100 grains of chipped coal (not powdered) over a blue gas flame from an Argand or Bunsen rose burner for ten or fifteen minutes; cool rapidly; reweigh with cover. Loss in weight from that of crucible, cover and 100 grains. Moisture.

III. Set the covered crucible with the dried coal over a good Bunsen or spirit lamp, and ignite for ten minutes or so after all flame has ceased to be given off. Cool and reweigh. Loss from weight at II. Volatile matter.

IV. The residual weight at III over that of crucible and cover. Coke.

V. Which can be burned in the same vessel should you wish to determine fixed carbon and ash.

The advantages of this method over that recommended by Mr. Hartman are:

1. No coal fire is required.

2. Moisture may be determined if you have gas at hand for the Argand or Rose burner.

3. There is no chance of getting either luting or ash of paper among the coke.

4. The porcelain is not so liable to alter in weight, nor absorb moisture in cooling as the pipe clay.

Respectfully yours,
ROBERT S. G. PATON.
Analytical Chemist.

Chemical and Scientific Repertory.

PARAFFINE IN LAVA BLOCKS.—S. Sylvestri has discovered the presence of "Paraffine in Lava Blocks." The quantities enclosed were sufficient to enable him to separate out and identify several hydrocarbons.—*Chemical News.*

DECOMPOSITION OF OIL OF TURPENTINE AT A HIGH TEMPERATURE.—G. Schultz has examined the products resulting from the "Decomposition of Oil of Turpentine at a High Temperature." The decomposition was effected in an iron tube heated to a dull red-heat, and from the black tar which resulted the following hydrocarbons were separated out: Benzene, toluen, xylen (principally 1 : 3), unchanged oil of turpentine, naphthaline, phenanthren, anthracene, and methylanthracene.—*Ibid.*

EFFECTS PRODUCED BY THE ADDITION OF FOREIGN BODIES TO CARBON IN THE PREPARATION OF COKE PENCILS FOR THE ELECTRIC LIGHT.—The addition of certain salts of magnesia and lime, especially bone-earth, was found to increase the light produced, but the flame and smoke accompanying these electro-chemical lights appeared such an obstacle in the way of their utilization that the experiments were discontinued.—*Ibid*

HEATING POWER OF FUELS.—As regards the heating of steam boilers, Mr. Thompson has found, by a series of experiments, that, on an average, only 47 per cent. of the theoretical heating power of the fuel is utilized, the remainder being lost through imperfect combustion, radiation and other causes. Since portable engines have been arranged for straw burning, this fuel has become of great importance for agricultural purposes. Trials at the Vienna exhibition proved that one pound of straw is capable of evaporating from 1.81 pounds to 1.97 pounds of water into steam of 70 pounds pressure and 305.6 deg. Fah.—*Polytechnic Review.*

THE FRIGHTFUL ACCIDENT AT ASHTABULA has aroused the public to the belief that efficient measures ought to be taken to better provide for the safety of railroad travelers. We notice that at Columbus, Ohio, a joint resolution was introduced in the legislature, instructing the governor to appoint three competent engineers to inspect the prominent railroad bridges of the State and was laid on the table to be discussed. At Washington, Mr. Wilson, of Iowa, offered a resolution requesting the Committee on Railroads to take into consideration and report whether it is wise and expedient to provide by law for the appointment of a National Board of Engineers, to supervise the construction of inter-state railroads, so far as safety to travelers is concerned. The expediency of urging such action as this was discussed at considerable length by the American Society of Civil Engineers some two years ago, and several of its members strongly advocated such a step.—*Polytechnic Review.*

Ventilation of Rooms.

Although Mr. Thicke's paper referred to several other details connected with the interior arrangement, warming, &c., of houses, the discussion mainly turned upon the question of ventilation, which was not to be wondered at, considering its paramount importance.

It was debated not only what were the best means for securing the ventilation of rooms, but also what is meant by good ventilation; and I was sorry to hear it suggested, by at least one speaker, that ventilation, together with other sanitary improvements, should not be pressed upon the poorer classes, and that a plentiful admission of fresh air into a room could not be accomplished without creating draughts. I could not agree in that opinion, and there is abundant evidence in London to the contrary.

General Cotton referred, for instance, to a ward in St. George's Hospital, where an abundant supply of fresh air was admitted by means of vertical tubes, with great success. So, also, at the Throat and Ear Hospital, and numerous other places.

It has been proved by demonstration, over and over again, that air admitted on this principal, judiciously applied as regards the height and area of the tubes, not only keeps an apartment fresh and wholesome, but the inmates neither feel any draught nor is the temperature uncomfortably lowered; on the other hand, it is equable in all parts of the room, and, therefore, in a healthy condition.

I was glad to hear General Cotton's testimony on this point. I had some tubes fixed in my own dining-room, and many of my friends have tried them, and so great was the improvement effected that they would not now be without them on any account.

In codsidering the effect of various methods of ventilation, many people omitted to take into account counteracting influences, and especially the diffusion of gases, and so were led to erroneous conclusions.

The pressure of the column of air entering a room by means of upright tubes, about half the height of the room, or less, was neutralized, or nearly so, by the time it reached the ceiling, owing to the higher temperature inside, and was then gradually diffused throughout the room by mixing with the air already present there.

An improvement in the system exhibited to the meeting by the Ventilation Company, of Victoria street, Westminster, was worthy of notice. It consisted chiefly in an arrangement for cleansing the air before it enters the upright tube, by means of a box fixed in the wall or air inlet, containing a trough of water, and furnished with deflecting plates which deflected the air on the water.

I have found this way effective in arresting dust and other dirty particles, which would otherwise find their way into the room.

The author of the paper proposed to introduce air through panels of wire gauze, fixed in doors and windows, in order to break the force of the current; but it had been found (as pointed out by one or two of the speakers) that both wire gauze and cotton wool get so soon choked with dirt as almost entirely to prevent the air passing through unless frequently cleansed. This fact points to the necessity in London and large towns of having such an arrangement as that exhibited for intercepting the dirt without interrupting the free inflow of the air.

With regard to extraction, it was found that in most cases the usual chimney opening or fire-place was sufficient, aided perhaps by an additional outlet, such as one of Bayle's Mica Flap Ventilators opening into the flue near the top of the room when there was a quantity of gas burnt. Even in summer time, when the fires are not alight, it was found that the air in a closed apartment is changed by means of these vertical tubes, and the tendency to down draughts in the chimney completely reversed.

It seems to me that those engaged in designing and building model lodging houses and workmen's cottages, could not do better than adopt this system of vertical tubes, which is the most simple, and at the same time the most efficient, method of ventilation by natural currents.

When the houses were building, omitting such a re-

finement as the water box or air purifier, and leaving holes in the brickwork for air inlets, these tubes might be put in at a cost not exceeding £5 for a six room cottage, with means of regulating the supply, and this would represent the expense of laying on a constant service of fresh air to the inhabitants, the value of which, from a hygienic point of view, could hardly be exaggerated.

I should deprecate the idea of bringing air into rooms through the doors which open on to the staircase or passage, because, as was pointed out by the chairman (Dr. Richardson), amongst others, in all ordinary construction the staircase is a sort of stink trap, up which ascend and in which are imprisoned all the smells and gases that are generated or given off from the lower part of the house, and it is well known that the houses of the poorer classes do, as a rule, contain very disagreeable odours. It is also objectionable to admit cold air at a low level in a room as it causes chilling draughts.

It would be far better, whenever possible, to take air direct from the outside of the house.

J. Livesey.

Journal Society of Arts.

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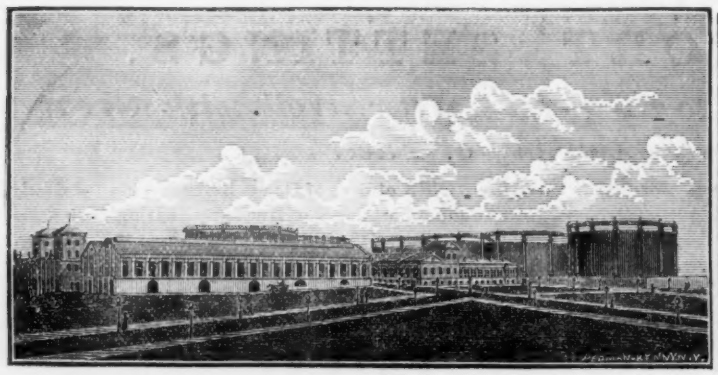

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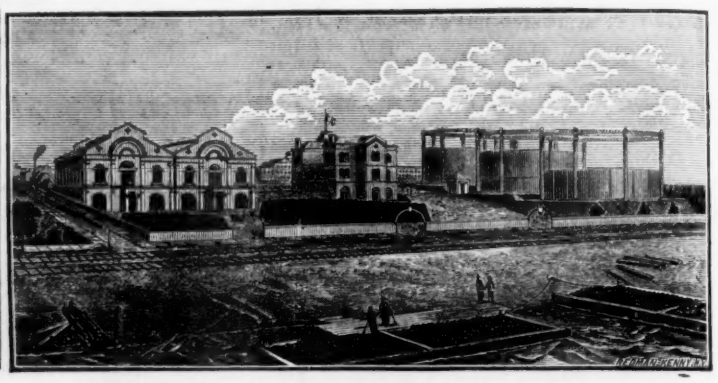

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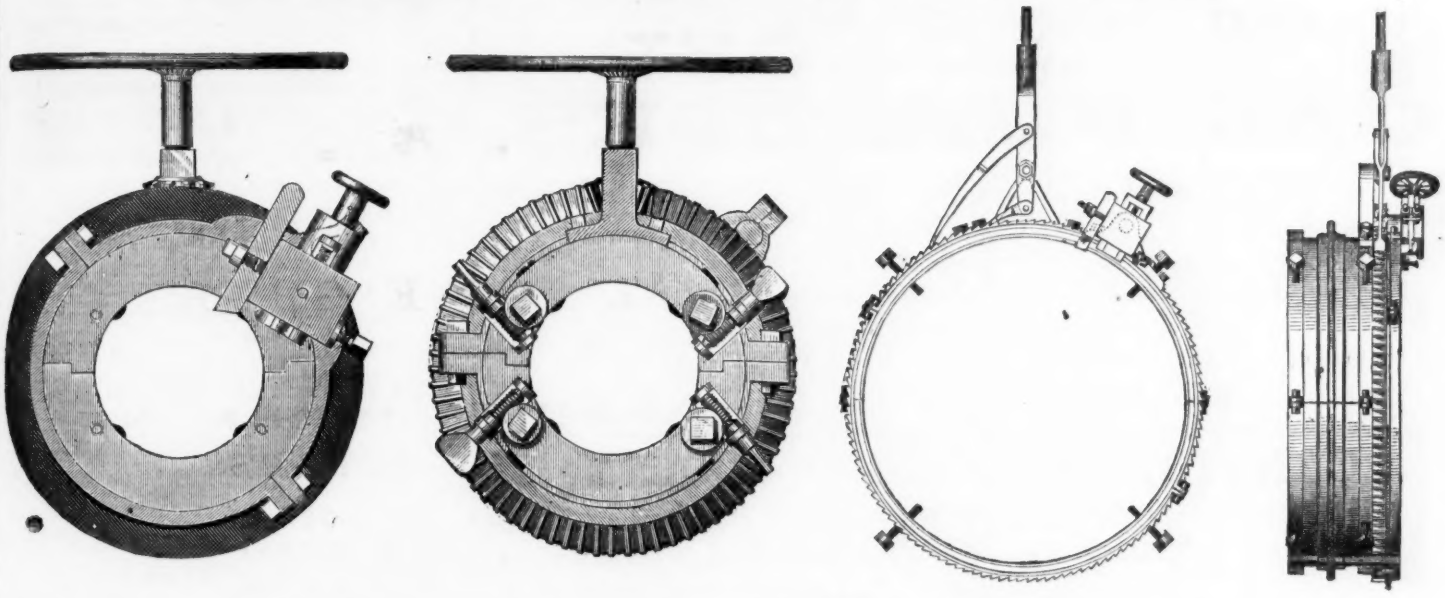

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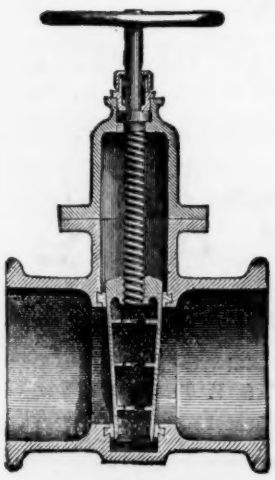

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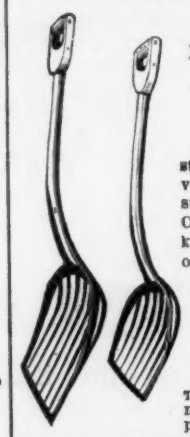

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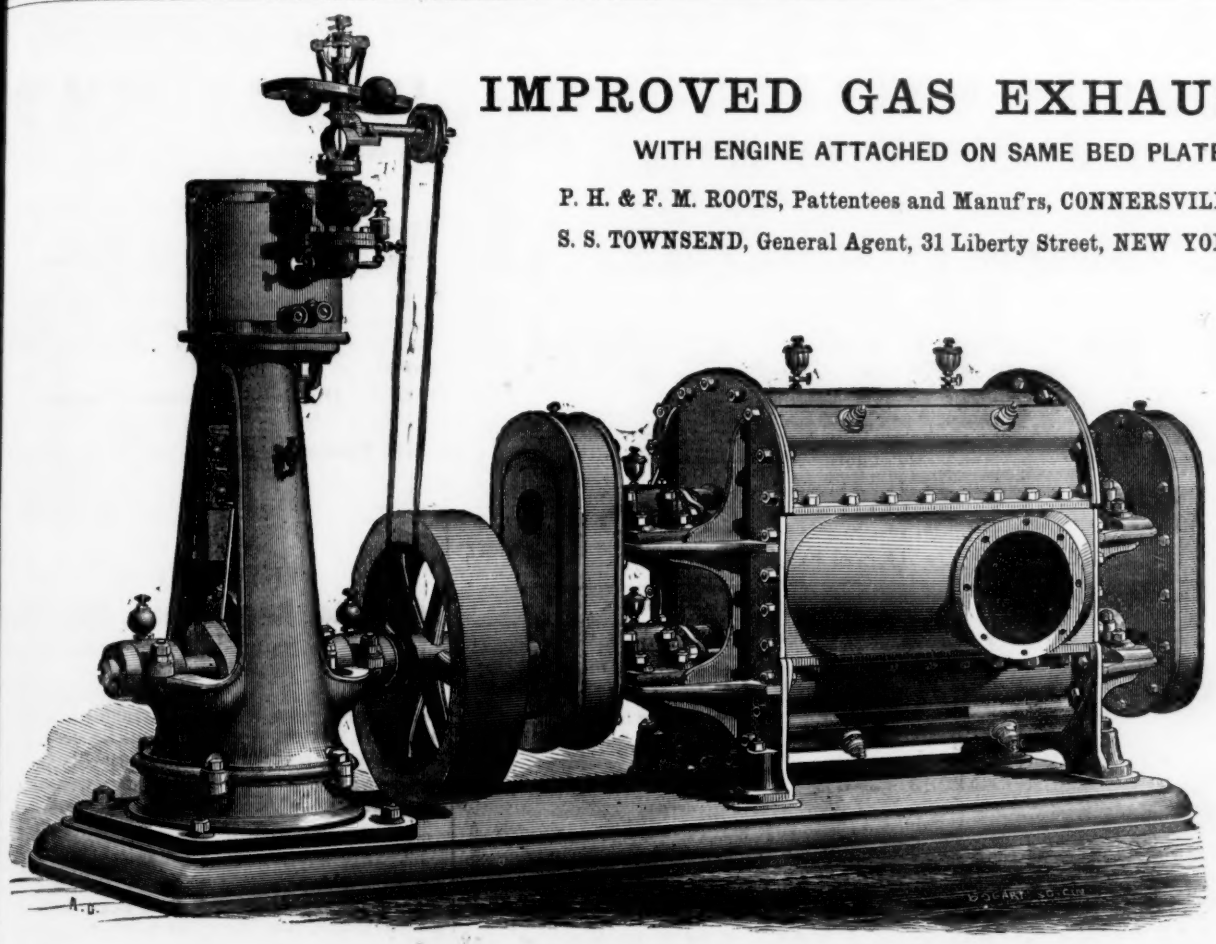

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Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.

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Among the consumers of Despard Coal, we name: Manhattan Gas Light Company, New York; Metropolitan Gas Light Company, New York; Jersey City Gas Light Company, N. J.; Washington Gas Light Company; Portland Gas Light Company, Maine.

*** Reference to them is requested. 204-

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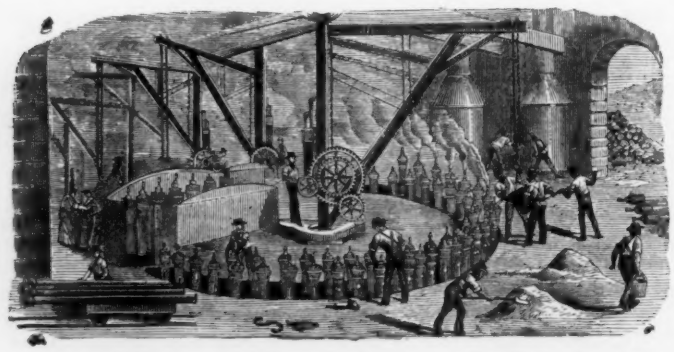

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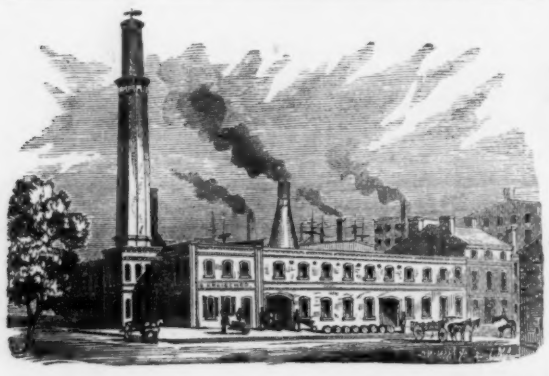

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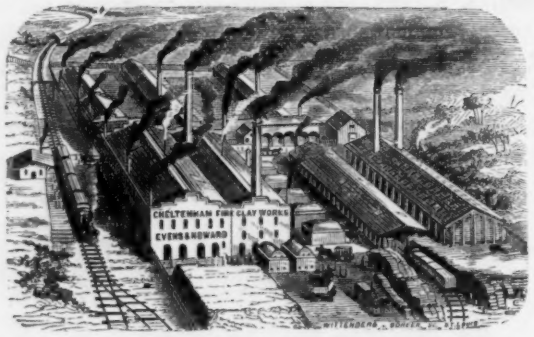

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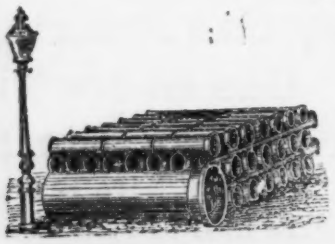

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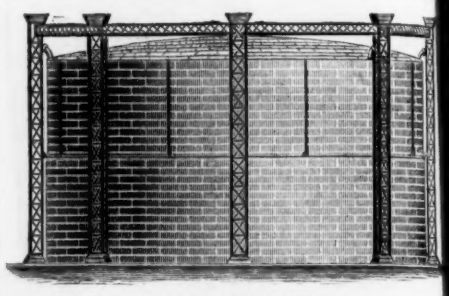

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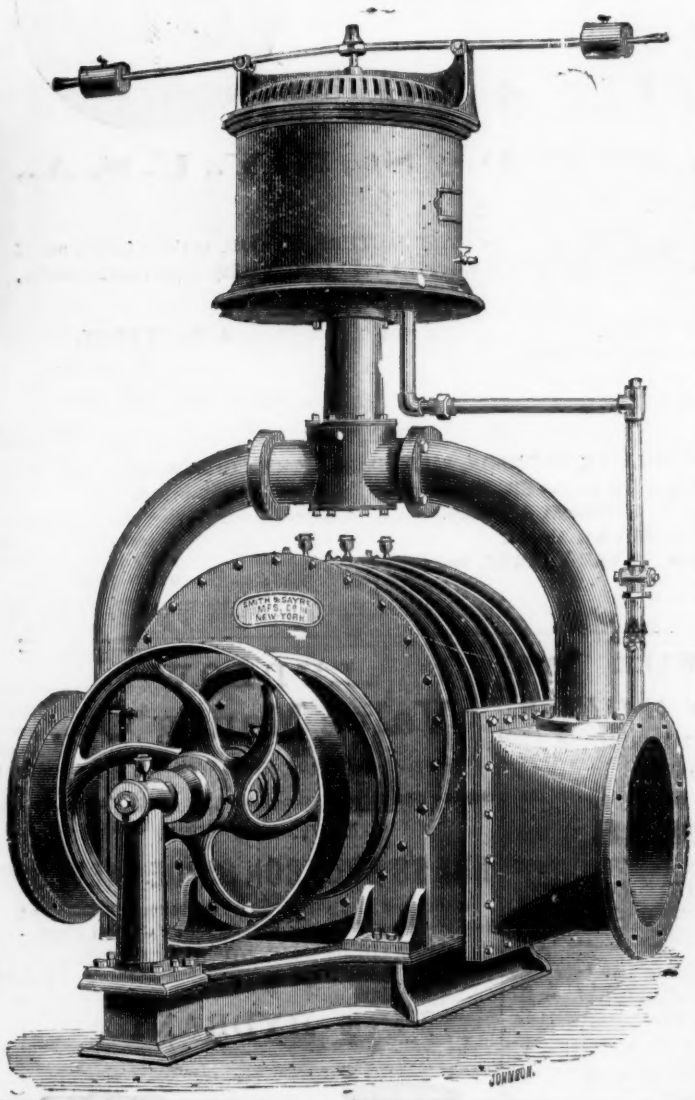

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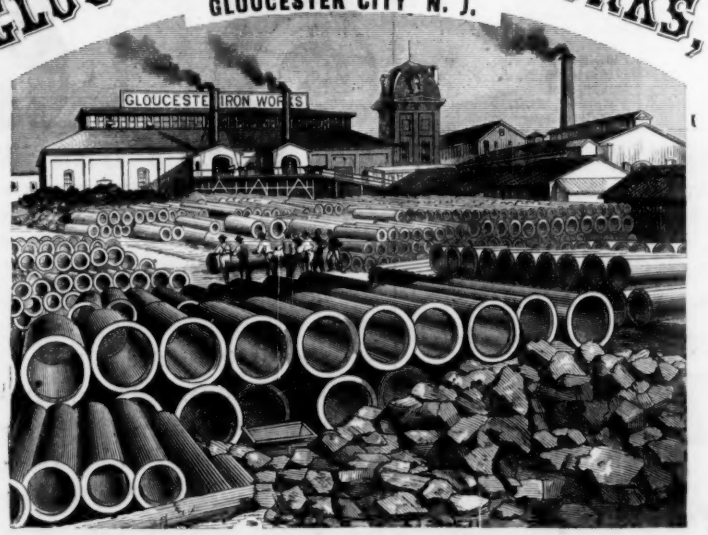

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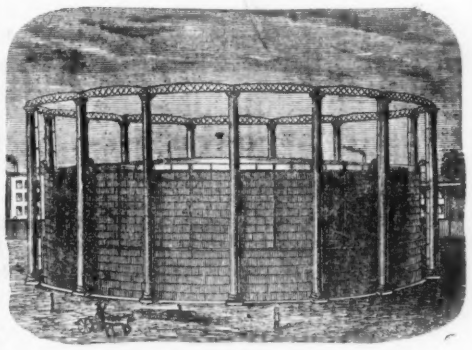

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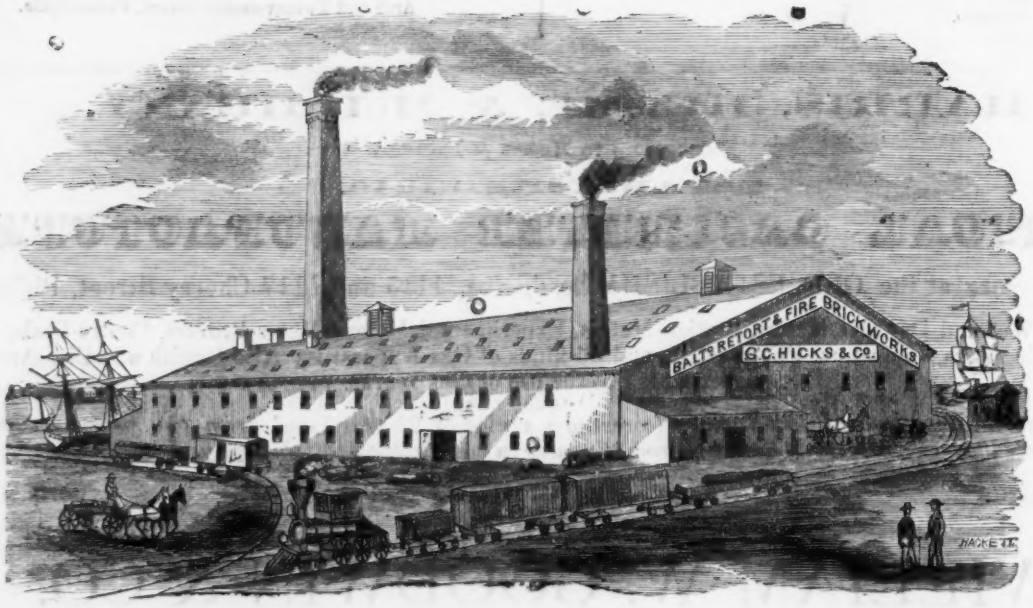

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"Yours truly, E. T. COX," *of the Centennial Jury of Awards.*